WHAT IS CLAIMED IS:

1. A dynamic interphase-loading apparatus (DILA) for testing the mechanical properties of an interphase region of a fiber/matrix composite under quasi-static to dynamic loading conditions, the apparatus comprising:

means for providing a quasi-static to dynamic load to the fiber/matrix interphase;

means for continuously monitoring the load applied to the fiber/matrix composite and providing a signal representative thereof;

means for continuously monitoring the displacement of the interphase of the fiber/matrix composite and providing a signal representative thereof;

means for forming various inputs signal to activate the piezoelectric actuator and to generate various displacement rates; and

a computing means for receiving the load signal from the load monitoring means, for receiving the displacement signal from the displacement monitoring means, and for providing an input signal to the piezoelectric actuator, the computing means having a memory means connected to a processing means, wherein the processing means stores the load signal in the memory means, generates the input signal supplied to the piezoelectric actuator, and generates information representing the mechanical properties of the interphase of the fiber/matrix composite.

2. The dynamic interphase-loading apparatus as recited in claim 1, wherein the information representing the mechanical properties generated by the computing means comprises the interfacial shear strength, frictional sliding stress, energy absorbing capability, and stress-strain response of the interphase of the fiber/matrix composite.

3. The dynamic interphase-loading apparatus as recited in claim 1, wherein the computing means generates information representing the durability of the interphase of the fiber/matrix composite.

4. The dynamic interphase-loading apparatus as recited in claim 3, wherein the information representing the durability of the interphase of the fiber/matrix composite comprises the fatigue life and the residual strength after fatigue loading or exposure to a hygrothermal environment of the interphase of the fiber/matrix composite.

5. The dynamic interphase-loading apparatus as recited in claim 1, wherein the load providing means comprises a piezoelectric actuator.

6. The dynamic interphase-loading apparatus as recited in claim 1, wherein the displacement monitoring means comprises a strain gauge bridge.

7. The dynamic interphase-loading apparatus as recited in claim 1, wherein the load monitoring means comprises a load cell.

8. The dynamic interphase-loading apparatus as recited in claim 1, wherein the means for forming various input signals comprises a waveform generator.

9. A method for testing the mechanical properties of an interphase region of a

fiber/matrix composite under quasi-static to dynamic loading conditions, the method comprising the steps of:

using a diamond tip as a probe to load the interphase;

providing a quasi-static to dynamic load to the fiber/matrix interphase;

debonding the fiber from the matrix at the interphase region and eventually pushing the fiber out from matrix;

continuously monitoring the load applied to the fiber/matrix composite and providing a signal representative thereof;

continuously monitoring the displacement of the interphase of the fiber/matrix composite and providing a signal representative thereof;

receiving the load signal and the displacement signals in a computing means having a memory means connected to a processing means;

providing a control signal to the piezoelectric actuator, via the computing means; and

using the processing means of the computing means to store the load signal in the memory means, generate the control signal supplied to the piezoelectric actuator, and generate information representing the mechanical properties of the interphase of the fiber/matrix composite.

10. The method for testing the mechanical properties of an interphase region of a fiber/matrix composite as recited in claim 9, wherein the information representing the mechanical properties generated by the computing means comprises the interfacial shear strength, frictional sliding stress, energy absorbing capability, and stress-strain response of the interphase of the fiber/matrix composite.

11. The method for testing the mechanical properties of an interphase region of a fiber/matrix composite as recited in claim 9, further comprising the step of using the processing means of the computing means to generate information representing the durability of the interphase of the fiber/matrix composite.

12. The method for testing the mechanical properties of an interphase region of a fiber/matrix composite as recited in claim 11, wherein the information representing the durability of the interphase of the fiber/matrix composite comprises the fatigue life and the residual strength after fatigue loading or exposure to a hygrothermal environment of the interphase of the fiber/matrix composite.

13. The method for testing the mechanical properties of an interphase region of a fiber/matrix composite as recited in claim 9, wherein the quasi-static to dynamic load provided to the fiber/matrix interphase is provided by a piezoelectric actuator.

14. The method for testing the mechanical properties of an interphase region of a fiber/matrix composite as recited in claim 9, wherein the displacement of the interphase is monitored with a strain gauge bridge.

15. The method for testing the mechanical properties of an interphase region of a fiber/matrix composite as recited in claim 9, wherein the load applied to the interphase is monitored with a load cell.